

Appl. No. 10/027,616
Atty. Docket No. 8782
Amdt. Dated 06/30/2004
Reply to Office Action of 03/30/2004
Customer No. 27752

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Withdrawn) An apparatus for treating a surface of a workpiece at approximately atmospheric pressure, said apparatus comprising:
 - a. a chamber for containing a plasma;
 - b. a first inlet having a first inlet orifice for admitting a plasma gas into said chamber;
 - c. a microwave radiation pathway connectable to a source of microwave radiation, wherein microwave radiation in said microwave pathway generates plasma from said plasma gas, said plasma being centered on a plasma core and having an inner plasma zone adjacent said plasma core and an outer plasma zone adjacent said inner plasma zone;
 - d. a second inlet having a second inlet orifice for admitting a working gas into said chamber, wherein said working gas generates excited species, said excited species of said working gas not having deleterious interaction with said plasma whereby substantial disintegration of said excited species is avoided; and
 - e. an outlet from said chamber for allowing said excited species to exit said chamber.
2. (Withdrawn) An apparatus according to claim 1, further comprising a plasma concentrator disposed within said chamber, said plasma concentrator concentrating said plasma at a predetermined location within said chamber, whereby said plasma core is juxtaposed with said plasma concentrator.
3. (Withdrawn) An apparatus according to claim 2, wherein said plasma concentrator comprises a rod, said rod being axially-symmetrically disposed within said chamber.
4. (Withdrawn) An apparatus according to claim 2 wherein said chamber has walls with an interior, wherein said plasma concentrator comprises a hollow ring, said ring having a periphery, said periphery of said ring inscribing said chamber walls,

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whereby said working gas can flow through said hollow ring of said plasma concentrator.

5. (Withdrawn) An apparatus according to claim 4 further comprising a second plasma concentrator, said second plasma concentrator comprising a hollow ring, said second plasma concentrator being disposed intermediate said first plasma concentrator and said outlet, whereby plasma is generated intermediate said first plasma concentrator and said second plasma concentrator.
6. (Withdrawn) An apparatus according to claim 1, further comprising a window transparent to microwave radiation and disposed on a wall of said chamber, said microwave radiation transmitting through said window into said chamber.
7. (Withdrawn) An apparatus according to claim 1, wherein said second gas inlet orifice is disposed intermediate said first inlet orifice and said outlet.
8. (Withdrawn) An apparatus according to claim 1 comprising a plurality of second inlet orifices, each for admitting a working gas into said chamber.
9. (Withdrawn) An apparatus according to claim 1 comprising a plurality of first inlet orifices each for admitting a plasma into said chamber.
10. (Withdrawn) An apparatus according to claim 7, further comprising an igniter for initiating the exciting of said plasma gas into a plasma.
11. (Withdrawn) An apparatus according to claim 10, wherein said igniter is removable from said chamber.
12. (Withdrawn) An apparatus according to claim 10, wherein said igniter comprises a dielectric barrier discharge device.
13. (Currently amended) A method of plasma treating a surface of a workpiece at atmospheric pressure, said method comprising the steps of:
providing a plasma generating apparatus comprising a chamber for containing a plasma, a first inlet having a first inlet orifice for admitting a plasma gas into said chamber, a second inlet having a second inlet orifice for admitting a working gas

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into said chamber, plural plasma concentrators spaced apart from one another and being disposed in said chamber for varying the density of the plasma within said chamber, an outlet from said chamber allowing a gaseous species to exit said chamber, and a microwave power supply for providing microwave radiation to said chamber and generating plasma from said plasma gas, whereby said plasma excites said working gas to create an excited species which exits said outlet to treat the surface;

supplying plasma gas through said first inlet and into said chamber;

providing microwave radiation from said microwave power supply to said plasma gas;

generating a plasma from the plasma gas using said microwave radiation, the plasma being concentrated near the plasma concentrators;

supplying working gas through said second inlet to said chamber, wherein said working gas bypasses said first inlet orifice ~~so that said working gas has minimal deterioration due to contact with the plasma~~;

exciting said working gas using the plasma to create an excited gaseous species;

juxtaposing said outlet with the workpiece to treat a surface of the workpiece; and

applying a treatment of the excited species to the surface of the workpiece at ~~approximately ambient pressure~~ a pressure at about 200 Torr to about 2500 Torr.

14. (Canceled)
15. (Currently amended) A method according to claim ~~[[14]]~~ 13 wherein said plasma is generated at atmospheric pressure.
16. (Original) A method according to claim 13, further comprising the step of moving said apparatus about said workpiece, thereby treating different portions of said surface of said workpiece.
17. (Original) A method according to claim ~~[[14]]~~ 15, wherein said step of supplying said plasma gas comprises the step of supplying an inert gas.
18. (Canceled)

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19. (Withdrawn) An apparatus according to claim 5 further comprising an first attenuator juxtaposed with at least one said plasma concentrator and being disposed radially outboard thereof.
20. (Withdrawn) An apparatus according to claim 9 comprising a microwave power supply for each of said first inlets.
21. (New) A method according to claim 13 further comprising the step of providing an inlet in each of said plasma concentrators and supplying a working gas through each said inlet in each said plasma concentrator.
22. (New) A method according to claim 21 wherein said step of providing plural plasma concentrators comprises the step of providing plural plasma concentrators having an annular shape, and disposing said plasma internal to said plasma concentrators.